

TRI-MAG, Inc.

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**TITLE:**

Instructions for using overlays for  
ESA-1000 FCC 20780 Class A

**DRAWN:**

**CHECKED**

**APPROVED**

**SCALE:**

**SHEET**

**NO.**

**DRAWING NO**

**REVISION:**

**of**

**A**

**TS-101**





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The overlays and instructions supplied are for use in FCC tests as outlined in Part 15 Subpart J for Class A Devices.

The equipment required for use with the overlays is as follows:

- 1) ESA-1000 Spectrum Analyzer with DM-1000 Memory Unit
- 2) LISN (50 uh and 50 ohm) Rated at the proper current
- 3) Biconical Antenna (Bia-25, 20-200 MHz)
- 4) Log Periodic Antenna (LPA-25, 200-1000 MHz)

## CONDUCTED MEASUREMENTS

In the frequency range of 0.45 - 30 MHz the FCC spec limit is given as follows for Conducted Interference:

Frequency (MHz):

|                       |         |
|-----------------------|---------|
| 0.45 to 1.6 . . . . . | 1000 uv |
| 1.6 to 30 . . . . .   | 3000 uv |

These voltages are converted to dBuv, which is decibels relative to one microvolt, by taking 20 times the logarithm to base 10 of the ratio of each to a one microvolt reference level:

$$20 \text{ Log} \left( \frac{\text{Voltage}}{1 \text{ uv}} \right) = \text{dBuv}$$

Thus the limit levels became:

|                       |         |
|-----------------------|---------|
| 0.45 to 1.6 . . . . . | 60 dBuv |
| 1.6 to 30 . . . . .   | 70 dBuv |

The impedance of the LISN is designed to match the impedance of the input power line and no correction factor is required.





## RADIATED MEASUREMENTS

The radiation limits for Class A Devices and the conversion to dBuV/m are given below:

| <u>Frequency (MHz)</u> | <u>Distance (m)</u> | <u>Limit (uv/m)</u> | <u>Limit (dbuv/m)</u> |
|------------------------|---------------------|---------------------|-----------------------|
| 30 - 88                | 30                  | 30                  | 29.5                  |
| 88 - 216               | 30                  | 50                  | 34                    |
| 216 - 1000             | 30                  | 70                  | 37                    |

When the distance (meters) is reduced from 30 meters to 10 or 3 meters the spec limit will increase by 10 dB and 20 dB respectively ( $20 \log \frac{d_2}{d_1}$ ) where  $d_2 = 30$  meters and  $d_1 =$  the distance of 10 or 3 meters.

The spec limit now becomes:

| <u>Frequency (MHz)</u> | <u>10 meters</u> | <u>3 meters</u> |
|------------------------|------------------|-----------------|
| 30 - 88                | 39.5 dBuV/m      | 49.5 dBuV/m     |
| 88 - 216               | 44 dBuV/m        | 54 dBuV/m       |
| 216 - 1000             | 47 dBuV/m        | 57 dBuV/m       |

The greatest potential error in the actual measurement involves the addition of the antenna factor to the spec limit. The factors of three samples for each of the two antenna models (Electro-Metrics BIA-25 and LPA-25) were taken and the resulting averages were used for the overlay. The antennas were calibrated according to ARP-958 at a 3 meter distance. If the antennas actually used for measurements do not match the factors used for the overlays, then an error can result. Antenna factors used are listed below.

If a signal being measured is close to the limit on the overlay, a manual measurement should be taken to insure compliance.

| <u>LPA-25</u>    |                  | <u>BIA-25</u>    |                  |  |  |
|------------------|------------------|------------------|------------------|--|--|
| <u>Freq. (m)</u> | <u>Factor dB</u> | <u>Freq. (m)</u> | <u>Factor dB</u> |  |  |
| 200              | 12.2             | 20               | 19.3             |  |  |
| 250              | 13.7             | 25               | 13.2             |  |  |
| 300              | 14.5             | 30               | 11.0             |  |  |
| 350              | 15.6             | 35               | 10.7             |  |  |
| 400              | 16.0             | 40               | 9.3              |  |  |
| 450              | 16.7             | 50               | 11.7             |  |  |
| 500              | 18.4             | 60               | 7.5              |  |  |
| 550              | 18.1             | 70               | 9.7              |  |  |
| 600              | 18.5             | 80               | 9.3              |  |  |
| 650              | 20.3             | 90               | 10.5             |  |  |
| 700              | 20.7             | 100              | 10.5             |  |  |
| 750              | 21.0             | 110              | 11.2             |  |  |
| 800              | 21.7             | 120              | 11.5             |  |  |
| 850              | 22.5             | 130              | 10.9             |  |  |
| 900              | 22.7             | 140              | 13.7             |  |  |
| 950              | 23.0             | 150              | 15.0             |  |  |
| 1000             | 24.7             | 160              | 15.3             |  |  |

  

| <u>BIA-25 (cont.)</u> |                  |
|-----------------------|------------------|
| <u>Freq. (m)</u>      | <u>Factor dB</u> |
| 170                   | 16.6             |
| 180                   | 15.8             |
| 190                   | 15.0             |
| 200                   | 16.5             |



## TEST SPECIFICATION

### ESA-1000 OVERLAY INSTRUCTIONS

#### 1. Control Setting of ESA-1000 for using Overlay I

##### CONDUCTED EMISSIONS FCC 20780 (.45 - 5MHz) Class A

|                |   |
|----------------|---|
| Bandwidth      | 9KHz                                      |
| Dispersion     | .5 MHz/DIV                                |
| ID Gain        | +20                                       |
| RF Att.        | -30                                       |
| Tuning         | Zero ref. sig. on Left Vertical Graticule |
| Field Strength | 5 db/DIV<br>Input Level                   |
| Detection Mode | Q.P.                                      |
| Scan Mode      | Auto or Single Scan                       |

With above conditions reference level reads 80 dBuV and Center frequency reads 2 or 3 MHz

Scan time should be set for approximately 10 sec/DIV

#### II. Control settings for using Overlay Ia

##### CONDUCTED EMISSIONS FCC 20780 (5 MHz - 30 MHz) Class A

|                |   |
|----------------|---|
| Bandwidth      | 9KHz  |
| Dispersion     | 5MHz/DIV  |
| IF Gain        | +20   |
| RF Att.        | -30   |
| Tuning         | Zero reference signal on Second Vertical<br>Graticule |
| Field Strength | 5 dB/DIV  |
| Detection Mode | Q.P.  |
| Scan Mode      | Auto or Single  |

With above condition reference level reads 80 dBuV and Center frequency reads 20 MHz

Scan time should be set for minimum / Div.







### III. Control settings for using Overlay II

#### RADIATED EMISSIONS FCC 20780 (30 MHz - 200 MHz) Class A

|            |  |
|------------|--|
| Bandwidth  | 120 KHz  |
| Dispersion | 20 MHz/DIV   |
| IF Gain    | +20 dB   |
| RF Att.    | 0  |
| Tuning     | 100 MHz (center frequency)<br>(Zero ref. on Left Vertical Graticule) |

|                |                         |
|----------------|-------------------------|
| Field Strength | 5 dB/DIV<br>Input Level |
|----------------|-------------------------|

|               |                     |
|---------------|---------------------|
| Detector Mode | Q.P.                |
| Scan Mode     | Auto or Single Scan |

With above conditions reference level reads 50 dB $\mu$ v and Center frequency reads 100 MHz

Scan time should be set for min/DIV.

### IV. Control Setting for using Overlay III

#### RADIATED EMISSIONS FCC 2 or 80 (200-400 MHz) Class A

Same as for Overlay # II EXCEPT

|        |                            |
|--------|----------------------------|
| Tuning | 300 MHz (Center Frequency) |
|--------|----------------------------|

### V. Control Settings for using Overlay IV

#### RADIATED EMISSIONS FCC 2 or 80 (400-600 MHz) Class A

Same as for Overlay # II EXCEPT

|        |                            |
|--------|----------------------------|
| Tuning | 500 MHz (Center Frequency) |
|--------|----------------------------|

### VI. Control Settings for using Overlay V

#### RADIATED EMISSIONS FCC 2 or 80 (600-800 MHz) Class A

Same as for Overlay # II EXCEPT

|        |                            |
|--------|----------------------------|
| Tuning | 700 MHz (Center Frequency) |
|--------|----------------------------|



VII. Control Settings for using Overlay VI

RADIATED EMISSIONS

FCC 2 or 80 (800-1000 MHz) Class A

Same as for Overlay # II EXCEPT

Tuning                    900 MHz (Center Frequency)



